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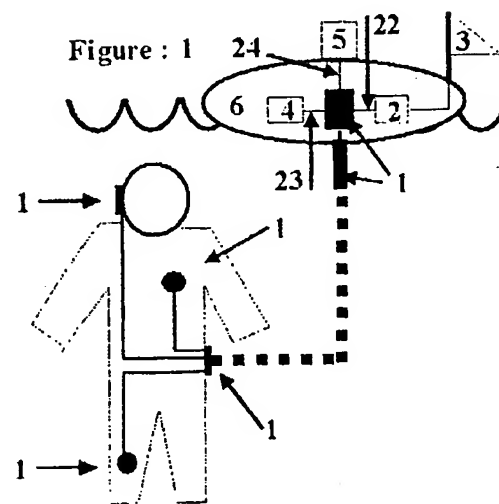
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G1N NEAN N19X5 N30PX N30P2 N30R

(56) Documents Cited:  
GB 2304444 A DE 019939302 A1  
FR 002741853 A1 FR 002655834 A1  
JP 100338193 A US 4681118 A

(58) Field of Search:  
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Other: Online: EPODOC, WPI, PAJ.

(54) Abstract Title: Portable underwater vital signs monitor

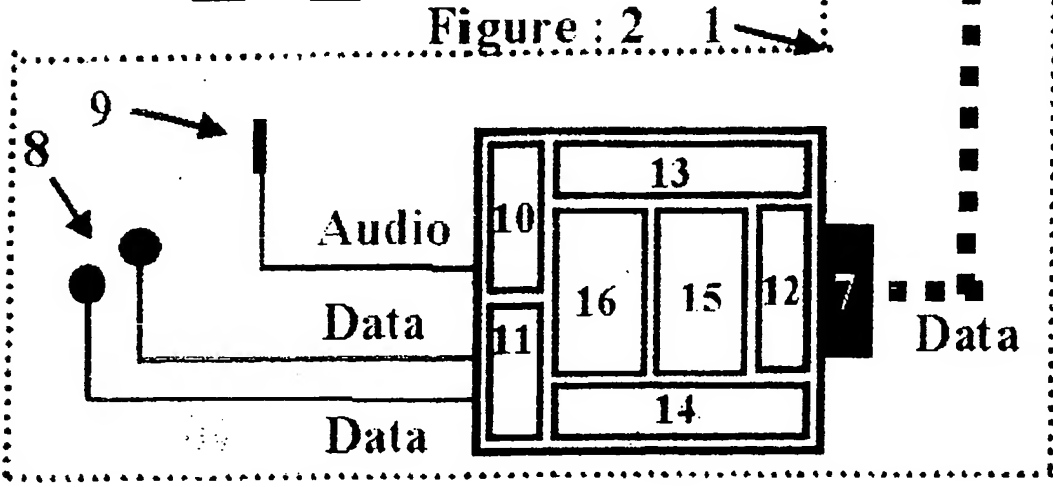
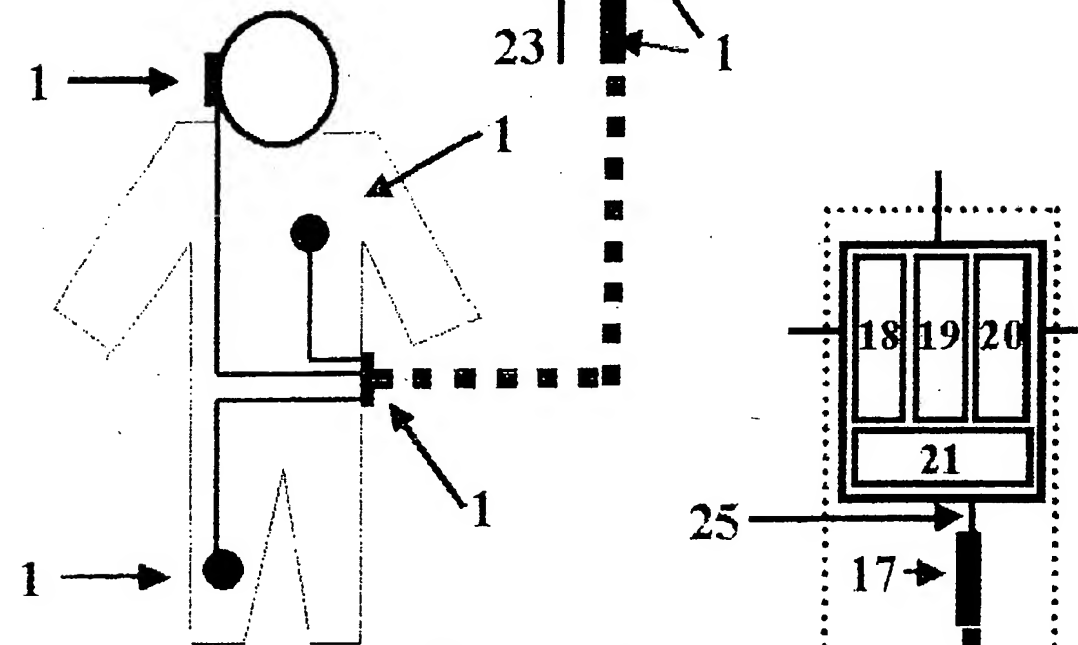
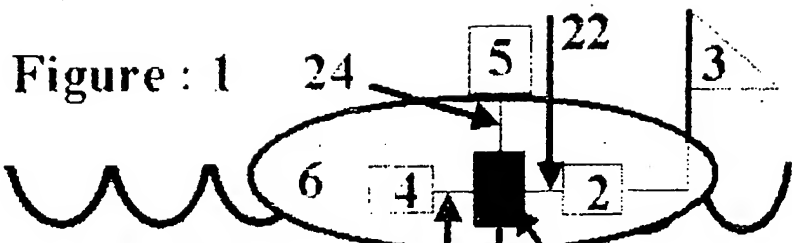
(57) A portable device 1 includes an underwater vital signs (e.g heart rate, blood oxygen) monitoring module and an emergency support module. The device is connected to a remote station 2, a GPS device 5, an audio device 4 and a floatation device (buoy 6). The device may be integrated into an underwater garment (e.g a wetsuit) with the support module at the surface to monitor divers. An alarm may be activated to indicate an emergency situation (e.g hypoxia) and may be used to remotely monitor the vital functions of underwater personnel. The device may include a depth meter, wireless communication interfaces, data storage and a text-to-speech module.



At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1995

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### The Aquacare

This invention relates to a portable device (i.e. that may be put anywhere convenient) that includes underwater vital signs (e.g. heartbeat, oxygen in the blood) monitoring and emergency support, which can be connected to a mobile station (MS), a location device (GPS), an audio device (AD) and a flotation device (BUOY).

To monitor vital signs on the surface is well known, but the developed systems are not applicable to monitor a person underwater. In some circumstances, for example free diving, there is the need to continuously monitor the users vital signs to predict emergency situations such as the on set of hypoxia.

The objective of this invention is to allow a person underwater to have their vital signs monitored either locally and/or remotely (external to the Aquacare) via the MS, to predict an emergency situation (e.g. Hypoxia) upon which an alarm can be triggered either locally on the person, and/or on the BUOY and/or remotely.

Accordingly, this invention uses body sensors to detect the users vital signs underwater, an underwater vital signs monitoring module and an emergency support module.

Preferably the Aquacare is made of lightweight metal and/or plastics material and is as small as desirable in size to be used as a portable device.

A preferred embodiment of the invention will now be described with reference to the accompanying drawings in which:

Figure 1 shows how the Aquacare will be connected to the MS (2) and its antenna (3), an AD (4) and a GPS (5). Collectively these can be connected to a BUOY (6).

Figure 2 shows a modular diagram of the Aquacare components.

As depicted in Figure 1, the Aquacare (1) can be connected to an MS (2) with an antenna (3) and an AD (4). The Aquacare (1) comprises of at least four I/O Interfaces 18,19,20 and 21 as detailed in figure 2. Data Interface 20 of (1) is used to transfer data to and from data interface 22 of the MS (2). Audio Interface 18 of (1) is used to transfer data to an AD (4) via its input interface 23. The GPS Interface 19 of (1) is used to transfer data from the GPS (5) via its output interface 24. The underwater Interface 21 of (1) is used to transfer data to and from the underwater transceiver (17) of (1) via its interface 25. The physical connections between 20 & 22, 18 & 23, 19 & 24 and 21 & 25 respectively may be either cable or wireless.

As shown in Figure 2, the Aquacare consists of two modules namely the emergency support module (18,19,20 and 21) and the vital signs monitoring module (7,8,9,10,11,12,13,14,15 and 16) each of these modules consists of, but is not restricted to, a number of interconnected sub-modules. Each of these sub-modules (18,19,20,21 and 7,8,9,10,11,12,13,14,15,16) may be either hardware (e.g. a chipset) or software (e.g. a program) or a combination of both. All the modules may also be combined in any combination, for example module 14 may be combined with 21 into a single chipset.

The AD Audio Interface (18) has at least 2 uses; firstly to connect the Aquacare to at least one AD and secondly, to convert any data to be sent to the AD into a format that can be used by the AD.

The GPS Data Interface (19) has at least 2 uses; firstly to connect the Aquacare to at least one GPS and secondly, to convert any data received into a format that can be used by the Aquacare.

The MS Data Interface (20) has at least 3 uses; firstly to connect the Aquacare to at least one MS, secondly, to convert any data received into a format that can be used by the Aquacare and thirdly, to convert any data to be sent to the MS into a format that can be used by the MS.

The Surface Data Interface (21) has at least 3 uses; firstly to connect the emergency support module to at least one underwater transceiver (17), secondly, to convert any data received from the vital signs monitoring module into a format that can be used by the emergency support module and thirdly, to convert any data to be sent to the vital signs monitoring module into a format that can be used by the vital signs monitoring module.

The Underwater Data Interface (12) has at least 3 uses; firstly to connect the vital signs monitoring module to at least one underwater transceiver (7), secondly, to convert any data received from the emergency support module into a format that can be used by the monitoring support module and thirdly, to convert any data to be sent to the emergency support module into a format that can be used by the emergency support module.

The Underwater Audio Interface (10) has at least 2 uses; firstly to connect the Aquacare to at least one underwater audio device and secondly, to convert any data to be sent to the underwater audio device into a format that can be used by the underwater audio device.

The Underwater Data Interface (11) has at least 2 uses; firstly to connect the Aquacare to at least one underwater vital signs sensor, secondly, to convert any data received into a format that can be used by Aquacare.

To facilitate flexibility the Aquacare may also include a microcontroller (16), a storage medium (14), a Text-To-Speech module (13) and a depth-meter (15).

Designed originally for the monitoring of free divers, but equally applicable in any underwater vital signs monitoring environment, an example of "Aquacare" is one that consists of two modules namely the *vital signs monitoring module* which is underwater and the *emergency support module* that are integrated into the free divers wetsuit and their marker surface buoy respectively. The wetsuit has built-in vital signs sensors (to detect for example heartbeat and oxygen in the blood) and an audio device for emergency alarms. These are connected to the Aquacare vital signs monitoring module and an underwater transceiver. The surface buoy contains a waterproof protected GPS device, a mobile phone, and an audio device. These are connected to the Aquacare emergency support module that is also connected to an underwater transceiver. The free divers vital signs recorded by the built-in wetsuit sensors are transmitted to the emergency support module, on the surface, via the transceivers. A microcontroller then interprets the sensors data and detects that the diver is starting to experience hypoxia. An alarm request is transmitted back to the diver, via the transceivers, and an audio alarm is played on the divers underwater audio device. Meanwhile, the Aquacare emergency support module has determined its location via the GPS and informed a remote emergency call centre by sending an SMS via the mobile phone. The emergency support module is also emitting an emergency siren via the audio device.

## CLAIMS

1. Aquacare includes an underwater vital signs monitoring module and an emergency support module, which are connected to a mobile station (MS), a location device (GPS), an audio device (AD) and a floatation device (BUOY).
2. Aquacare as claimed in any preceding claim including a cable connection between the vital signs monitoring module and the emergency support module.
3. Aquacare as claimed in claim 1 where the vital signs monitoring module and the emergency support module are either combined hardware components or separate hardware components.
4. Aquacare as claimed in any preceding claim including a wireless interface between the Aquacare and the MS.
5. Aquacare as claimed in any preceding claim including a wireless interface between the Aquacare and the audio device.
6. Aquacare as claimed in any preceding claim including a wireless interface between the Aquacare and the GPS.
7. Aquacare as claimed in any preceding claim including a wireless interface between the Aquacare and the AD.
8. Aquacare as claimed in any preceding claim including an audio device.
9. Aquacare as claimed in any preceding claim including a mobile station.
10. Aquacare as claimed in any preceding claim including a location device.
11. Aquacare as claimed in any preceding claim including a floatation device.
12. Aquacare as claimed in any preceding claim including a depth meter.
13. Aquacare as claimed in any preceding claim including a storage medium.
14. Aquacare as claimed in any preceding claim including a Text-To-Speech module.
15. Aquacare as claimed in any preceding claim including a microcontroller.
16. Aquacare substantially as herein described and illustrated in the accompanying drawings.



Application No: GB 0126878.8  
Claims searched: 1 at least.

Examiner: Eleanor Thurston  
Date of search: 25 April 2003

## Patents Act 1977 : Search Report under Section 17

### Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance	
Y	1 at least.	DE 19939302 A	(KABUFFERT) see EPODOC abstract and WPI abstract Accession Number 2001-410020 [44].
Y	1 at least.	FR 2741853 A1	(BOUZEHOUE) see EPODOC abstract and WPI abstract Accession Number 1997-322715 [30].
Y	1 at least.	FR 2655834 A1	(COLLOT) EPODOC abstract and WPI abstract Accession Number 1991-254842 [35].
Y	1 at least.	JP 100338193 A	(SEIKO) see PAJ abstract and WPI abstract Accession Number 1999-114426 [10].
Y	1 at least.	GB 2304444 A	(SMITH) see abstract.
Y	1 at least.	US 4681118 A	(ASAI et al) see abstract and figure 5.

### Categories:

X Document indicating lack of novelty or inventive step	A Document indicating technological background and/or state of the art.
Y Document indicating lack of inventive step if combined with one or more other documents of same category.	P Document published on or after the declared priority date but before the filing date of this invention.
& Member of the same patent family	E Patent document published on or after, but with priority date earlier than, the filing date of this application.

### Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC<sup>v</sup>:

G1N

Worldwide search of patent documents classified in the following areas of the IPC<sup>v</sup>:

A61B; B63C.

The following online and other databases have been used in the preparation of this search report:

EPODOC, WPI, PAJ.